Page

Page

This section integrates project effects by species and life-history stage to evaluate the overall effect on populations of each species. To integrate and assess effects of the proposed project, the timing and locations of operational activities are correlated with temporal and spatial characteristics of listed fish populations, including life-history strategy, habitat use, and geographical distribution. The following discussion tracks each species through their life-history in the Russian River to determine the interactions with the project and identify the potential collective effects. The effects of the individual actions were summarized in Section 5.7. This analysis focuses on the most important potential project effects, both positive and negative, to provide perspective on how the proposed project will affect the ability of the coho salmon, steelhead, and Chinook salmon to complete their lifecycles and contribute to future generations.

Chinook salmon use the Upper and Middle mainstem Russian River and Dry Creek for migration, spawning, and rearing, while coho salmon use the mainstem largely as a migration corridor. Coho salmon rely on tributaries for spawning and rearing. Steelhead use both the mainstem Russian River and tributary habitat for spawning and rearing. All three species can potentially use Dry Creek for spawning and rearing, but suitable coho salmon habitat is limited.

This analysis focuses on identifying the effects of proposed project actions on upstream migration, spawning/incubation, rearing, and emigration of the listed species. Limiting factors are identified, where known, so that key project effects, both negative and positive, can be identified. Effects are integrated over all life-history stages to determine the overall effect of the proposed project on salmonids and their habitat.

Project effects are classified into one of three categories:

- Negative effects that were identified under baseline operations, but which are reduced to minimal or no effect under the proposed project. The proposed project would, in these cases, provide a benefit over baseline conditions.
- Effects that may negatively affect salmonids or their habitat.
- Beneficial effects.

In each case, project effects are evaluated for improvements over baseline conditions and for their overall effect on populations of coho salmon, steelhead, and Chinook salmon and their habitats.

6.1 COHO SALMON

Coho salmon have a fixed 3-year lifecycle. Peak adult upstream migration generally occurs November through January. Spawning takes place from December to mid-February, and eggs can incubate as late as the end of March. Fry begin to emerge as early as February and as late as the first part of April, and juveniles spend approximately one year in freshwater tributaries before becoming smolts. Smolt emigration usually occurs between February and mid-May.

Coho salmon primarily use tributaries to the Lower Russian River and Dry Creek for spawning and rearing and use the mainstem for migration. Many of the tributaries that currently support coho salmon are downstream of the water diversion operations at Mirabel. These habitat-use patterns tend to separate coho salmon from some project operations. In some cases, potential project effects are low because coho salmon abundance is low and their distribution is limited.

An important limiting factor for coho salmon is rearing habitat. Survival during the rearing period is affected by such factors as water quality, flow rates, the amount of large woody debris in streams, and the size of riparian buffer zones. There are several project activities that should help improve rearing habitat in streams already occupied by coho salmon and in streams that could potentially support coho salmon populations in the future (e.g., tributaries to Dry Creek, Laguna De Santa Rosa, and Mark West Creek).

The proposed project has little opportunity to negatively affect returning adults, as current populations are primarily limited to a few tributaries. However, to reduce the chance of extirpation from the Russian River, coho salmon populations must eventually occupy a much greater number of tributaries in the basin (ENTRIX, Inc. 2003b). Thus, any project activities that improve conditions for upstream and downstream migration could play an important role in the recovery of viable coho salmon populations in the Russian River.

6.1.1 EFFECTS OF THE PROPOSED PROJECT ON COHO SALMON

In this section, project effects are integrated by life-history stage for coho salmon. In general, implementation of project activities is likely to either reduce negative effects relative to baseline conditions, or provide potential benefit. A few ongoing activities, however, could still adversely affect coho salmon, particularly downstream migration.

6.1.1.1 Upstream Migration

The proposed project should provide some benefit to coho salmon during the upstream migration period. Project activities that are expected to improve conditions for adult migration include the Flow Proposal (in Dry Creek), the habitat restoration programs, and maintenance practices in the flood control channels.

In the Russian River and Dry Creek, the proposed project flows would generally provide suitable conditions for upstream migration under *all* and *dry* water supply conditions. Temperature during the migration period is predicted to be suitable for adult migration

more than 90 percent of the time. The Flow Proposal would improve conditions for upstream migration in upper Dry Creek relative to the current D1610 management scenario, which may help coho salmon recolonize tributaries in this area of the watershed.

Habitat restoration projects in tributaries to the Lower Russian River and Dry Creek would benefit fish passage to historic coho salmon streams. Instream structures in Dry Creek may slightly enhance passage to Dry Creek tributaries by providing increased cover from predators and creating pools to provide refuge for migrating adults during high flows. Habitat restoration projects in Santa Rosa Creek may also provide enhanced passage opportunities to high-quality spawning and rearing habitat in upstream areas. This may help offset potential negative effects due to channel maintenance activities in constructed channels in this portion of the watershed.

Restoration actions in the constructed flood control channels, such as planting native trees in riparian zones and installing instream structures, would help improve fish passage to historic coho streams in the Mark West Creek watershed. Channel reconstruction, bank stabilization, and riparian planting at the mouth of Big Austin Creek would also help increase access to prime coho salmon rearing and spawning habitat in East Austin, Gillian, and Willow creeks. While coho salmon are currently absent or in low abundance in the Mark West Creek and Big Austin Creek watersheds, these restoration projects should help facilitate the recolonization of historic coho salmon streams in the Lower Russian River. The ongoing effects of the project on upstream migration are currently negligible because they occur in reaches where coho salmon are currently absent. These effects could become more important in the future should the distribution of coho salmon populations increase. For instance, sediment maintenance activities in constructed flood control channels could pose a small risk to upstream migration in Santa Rosa Creek and Laguna de Santa Rosa (should they recolonize the Mark West Creek watershed). However, the effects of sedimentation on fish passage in this area should be offset by the proposed changes in channel maintenance practices. Thus overall, conditions for upstream migration is likely to improve in these streams relative to baseline conditions.

6.1.1.2 Spawning and Egg Incubation

Spawning and incubation habitat is less limiting for coho salmon in the Russian River than rearing habitat. Currently, spawning and incubation occur primarily in tributaries to the Lower Russian River mainstem, which for the most part are unlikely to be affected by project activities.

The proposed project should provide some benefit to coho salmon during spawning and incubation. Project activities that are expected to improve habitat conditions are the Flow Proposal and instream habitat restoration proposed for Dry Creek.

The Flow Proposal would provide improved spawning conditions for coho salmon in Dry Creek relative to current water management practices under D1610. This is especially true in upper Dry Creek, where daily flows are predicted to provide a higher frequency of

suitable spawning and incubation flows relative to baseline, especially in *dry* water supply conditions and at full buildout demand.

Instream habitat projects planned for Dry Creek would also improve spawning and incubation conditions for coho salmon. These actions would increase the extent of riffles within channels that serve as prime spawning areas for coho salmon. Instream habitat structures, such as large woody debris, would also help reduce the chance of redd scour during storm events, thereby increasing the overall egg-to-fry survival rate.

6.1.1.3 Juvenile Rearing

Because coho salmon rear year-round, summer-rearing habitat is thought to be an important limiting factor for Russian River coho salmon. Much of the rearing habitat is currently located in tributaries in the Lower Russian River (e.g., Green Valley Creek and Maacama Creek). There are several project activities that would improve summer rearing conditions for juvenile coho salmon. These activities include the Flow Proposal in Dry Creek, habitat restoration projects, educational programs, changes in Estuary management, and water recycling programs.

The Flow Proposal would provide dramatically improved summer rearing conditions for coho salmon in Dry Creek relative to D1610, especially at buildout demand levels. Daily flows under the Flow Proposal are expected to provide good to optimal rearing conditions 90 to 95 percent of the time at current demand, and 75 to 80 percent of the time at buildout demand levels throughout Dry Creek. Under D1610, flows are expected to provide good juvenile rearing conditions less than 30 percent of the time. Given that summer rearing is often the limiting factor of coho salmon production in freshwater streams (Nickelson and Lawson 1998), the Flow Proposal should have important beneficial effects for the recovery of coho salmon in the Russian River.

Juvenile rearing habitat has also been marginal in Dry Creek and its tributaries due to high velocities, and a lack of large woody debris and other instream structures. The habitat improvement projects planned for this region would provide localized habitat complexity and benefit young coho salmon through the creation of scour, plunge, and backwater pools. Pool habitat is essential for juvenile survival because it provides a refuge for high flows, cover from predators, and suitable rearing temperatures.

Habitat improvement programs are targeted for other Russian River tributaries capable of supporting coho salmon. Riparian and instream restoration programs that benefit coho salmon have the highest priority for implementation. These types of projects provide localized improvements in rearing conditions and would increase the availability of good-quality coho salmon habitat. Habitats with a smaller potential to provide improved rearing conditions for coho salmon are the Estuary and the Upper Russian River; coho salmon have not been found in either location. If coho salmon populations increase, these areas could contribute positively to rearing opportunities and play an important role in the recovery of coho salmon in the Russian River watershed.

One of the most significant challenges for juvenile coho salmon is the removal or reduction of riparian vegetation along tributary streams. SCWA is actively engaged in several programs to help educate the public and local landowners to the importance of riparian corridors. For example, the North Bay Watershed Association program seeks to bring together farm organizations, environmental groups, and government agencies to develop a set of BMPs, develop TMDL regulations, explore the use of recycled water, institute pollution prevention, and other measures. The goals of this program are to restore and enhance the fish habitat in the Russian River watershed.

Under the Flow Proposal, summertime artificial breaching of the sandbar at the mouth of the Russian River would be eliminated. This would likely result in improvements in summer rearing habitat in the lagoon, which may benefit coho salmon. Many of the streams currently used by coho salmon are close to the Estuary. Young coho salmon in other systems move down out of their natal tributaries and may take up residence in the upper portion of the Estuary.

Finally, SCWA is developing a recycled water program to reduce the amount of surface flows used for agricultural irrigation. The recycled water would supplant the use of natural flows from tributaries, thereby improving summer rearing opportunities for coho salmon. This program would help improve flows in Dry Creek tributaries and Macaama Creek.

One potential negative effect of the project on juveniles is the operation of the Spring Lake flood control reservoir. The diversion inlet to the reservoir is located near good-quality spawning and rearing habitat on Santa Rosa Creek, so juveniles could become trapped in the reservoir during high-flow events. Although there are currently no known coho salmon populations in this area, restoration efforts to improve habitat in Santa Rosa Creek (and other streams in the Mark West Creek watershed) may result in expanding coho salmon distribution to the upper portion of Santa Rosa Creek. If coho salmon begin to use this area, young coho salmon could be affected by the diversion inlet. However, given that flooding occurs infrequently in the Spring Lake area, the overall risk to juvenile coho salmon would be low.

6.1.1.4 Juvenile Downstream Migration

The project would be expected to improve conditions for downstream migration of smolts relative to baseline operations. The greatest project benefits to coho salmon migration would be associated with proposed changes in operations in the Mirabel and Wohler areas.

In particular, the diversion structure and fish ladder on the west side of the inflatable dam would be modified to improve downstream fish passage. The addition of the notch in the inflatable dam would create a high-velocity flow field that would entrain juveniles and help them pass quickly over the dam, thereby minimizing migration delays. Yearly regrading of the Wohler infiltration ponds would also improve fish passage by directing smolts entrained during winter storms towards the inlet pipe, allowing them to quickly return to the river. Finally, upgrading fish screens at the intake structures at Mirabel and

Wohler to meet NOAA Fisheries criteria would reduce the chance of take during downstream migration.

Some potential risks remain for young coho salmon as they migrate downstream. During the first 8 hours after the inflatable dam is raised, there is a small risk of stranding smolts or exposing them to avian predation as flows are reduced in the reach just downstream of the dam. Smolts could still be delayed at the inflatable dam if they have difficulty locating the augmented flow channel through the notch. They could also fall prey to predatory fish in Wohler Pool or in Wohler infiltration ponds. Finally, entrapment is still possible in Spring Lake or the ponds at Riverfront Park. Both of these facilities are situated near coho salmon rearing habitat. Riverfront Park is located close to several quality coho salmon tributaries, including Mill and Felta creeks, while Spring Lake is located near potential coho salmon habitat on Santa Rosa Creek.

6.1.1.5 Fish Production Programs

One of the most significant benefits of the proposed project to coho salmon is the initiation of a supplementation program using the fish production facilities at DCFH. A coho salmon integrated recovery program, initiated by CDFG and NOAA Fisheries in 2001, would continue at DCFH, replacing previous baseline production goals of mitigating the loss of coho salmon habitat due to the construction of Warm Springs Dam.

The fish production program would rear juvenile coho salmon collected in the Russian River watershed, use them as broodstock, and seed progeny into streams in the Lower Russian River basin. The objectives of the captive broodstock program are to: 1) prevent extirpation of Russian River coho salmon, 2) preserve genetic, ecological, and behavioral attributes of Russian River coho salmon while minimizing potential effects to other stocks and species, and 3) build a naturally sustaining coho salmon population. This program could be very instrumental in helping juveniles recolonize historic coho salmon streams, leading to the long-term enhancement of coho salmon populations in the Russian River.

6.1.2 Coho Salmon Response to the Proposed Action

The overall beneficial effects of the proposed project are summarized in Table 6-1. In general, the project activities would improve habitat for coho salmon and should play an important role in the recovery of coho salmon populations in the Russian River. There are a few ongoing project activities that could negatively effect downstream migration. However, changes in these activities would improve outmigration over baseline conditions (Table 6-2).

Table 6-1 Potential Project Benefits to Coho Salmon

Life-History Stage	Project Benefits
Adult upstream migration	Implementation of the Flow Proposal in Dry Creek.
	Instream restoration projects that increase cover and high-flow velocity refuge to priority coho tributaries.
Spawning and incubation	Instream habitat structures in Dry Creek and other streams to help maintain spawning gravels.
Juvenile rearing	Implementation of the Flow Proposal in Dry Creek.
	Instream habitat improvements.
	Recycled water projects.
	Educating the public on the importance of riparian corridors.
Juvenile downstream migration	Fish screens at Mirabel diversion.
	Exit channel at Wohler infiltration pond.
	Notching of Wohler Dam.
All life stages	Captive Brood supplementation program.

Table 6-2 Potential Project Effects on Coho Salmon

Life-History Stage	Low Continued Risks
Juvenile downstream migration	Stranding during inflation of Mirabel Dam.
	Predation in Wohler Pool or infiltration pools.
	Entrapment at Riverfront Park lakes.
	High summer flows during *critically dry* years

6.1.2.1 Integration of Project Effects on Coho Salmon Habitat

Integration of the effects over all project activities indicates that habitat conditions for coho salmon would be improved throughout historic coho salmon streams in the Russian River watershed. Habitat improvements would affect all stages of the freshwater coho salmon lifecycle in a positive manner and should help facilitate their recovery.

Project activities that are most likely to benefit coho salmon are the instream habitat improvements and the Flow Proposal. These projects would have the greatest effect on rearing habitat and juvenile survival. This could have a profound effect on population growth rates because summer and over-wintering habitat are typically considered limiting factors for coho salmon in freshwater streams (Nickelson and Lawson 1998). Summer flows in Dry Creek at buildout during *critically dry* years would be improved over D1610, but may still be high for rearing coho salmon.

Instream restoration actions are most likely to have the most immediate effect on coho salmon abundance, as they are slated for tributaries in the Lower Russian River basin, including high-priority coho salmon streams (e.g., Green Valley, Felta, Dutch Bill,

Turtle, and Big Austin creeks). These actions include placing large woody debris or other instream structures in streams to create more pool habitat where juveniles can rear. Additional actions include planting riparian vegetation to provide protective cover from predators, reduce water temperatures, and provide additional habitat for invertebrates.

The implementation of the Flow Proposal in Dry Creek would improve rearing conditions, especially in the Upper Reach, and could help facilitate the recovery of viable coho salmon populations in Dry Creek and its tributaries. The Flow Proposal would also provide better conditions for spawning and upstream migration, increasing the probability that abundances in this region would increase in the future.

Other project activities that would improve rearing conditions over baseline include public education on the importance of riparian corridors, and the use of recycled water for agriculture.

Several proposed project actions would improve conditions for upstream and downstream migration, including modifying the fish screens at the Mirabel diversion, adjusting operations of the Mirabel inflatable dam, creating an exit channel at the Wohler infiltration pond, and creating a notch in the Mirabel inflatable dam. These actions would reduce habitat fragmentation by allowing coho salmon to more easily access historic coho salmon tributaries in the Lower Russian River and Dry Creek. This would increase the amount of rearing and spawning habitat available to coho salmon in the Russian River basin. Given that habitat destruction is a primary cause of species decline, increasing the quality of migration habitat to quality coho salmon tributaries (i.e., improving habitat connectivity) is an important step in the recovery process.

The quality of spawning habitat would also improve as a result of instream project activities. In particular, SCWA would add instream structures at suitable locations in Dry Creek to increase habitat complexity and to capture and hold coho salmon spawning gravels. This should increase the amount of riffle habitat preferred by coho salmon for spawning and help reduce redd scour.

Finally, implementation of the captive broodstock program would help prevent extirpation and increase the distribution of coho salmon in the Russian River basin. Currently, low abundances of returning adults leave coho salmon vulnerable to extinction risks associated with demographic and environmental stochasticity. Given the high potential for inbreeding depression in traditional hatchery programs, supplementation via a captive broodstock program may provide the best option for building up local coho salmon populations, while preserving the genetic variability found within the Russian River watershed. The captive broodstock program would help reverse declining trends in coho salmon and facilitate the recolonization of barren coho salmon streams with good-quality coho salmon habitat.

Although project activities are expected to improve downstream migration relative to baseline conditions, there would still be potential ongoing negative effects that could impede smolt migration. For instance, there would still be a risk of entrapment in the Riverfront Park lakes and the Spring Lake flood control reservoir. The risk would be

greatest for the Riverfront Park lakes, because they are located near coho salmon migration corridors in the lower mainstem and are frequently overtopped by flood flows. Other possible risks to juveniles during downstream migration include stranding during the inflation of the Mirabel dam and an increased risk of predation for fish swept into the Wohler infiltration pools.

Given the overall improvements to rearing habitat and fish passage, as well as the implementation of the broodstock program, any lingering negative effects due to the flood control reservoirs and the pools at Wohler should be relatively small. The effect of entrapment and stranding along the mainstem corridor could be seen as marginally reducing the survival rate of smolts in more upstream tributaries. However, given the proposed improvements at the diversion facilities, the chance of having viable populations in Dry Creek and the Mark West Creek watershed should improve. Combined with improvements in habitat conditions, the Flow Proposal, and the captive broodstock program, the distribution and abundance of coho salmon in the Russian River should increase.

6.2 STEELHEAD

Unlike coho salmon, steelhead do not have a fixed 3-year lifecycle. They typically spend 2 years in the ocean before returning to spawn, and may return to the ocean after spawning to spawn again in a later year. Peak adult upstream migration occurs from January through March.

Steelhead usually spend 1 or 2 years rearing in fresh water, but can remain for longer periods of time before migrating to the ocean. Steelhead rear year-round in the tributaries and throughout the Middle and Upper mainstem. Their distribution is widespread in the Russian River watershed, including Dry Creek and its tributaries.

While some juveniles rear in the Lower mainstem before smolt outmigration, summer water temperatures in much of this region are too warm to provide suitable conditions for juveniles in most years. Tributaries in the Lower reaches tend to provide less vegetative cover, are often wide and shallow, and have little riparian vegetation. Water temperatures in the mainstem near the coast are cooler, and the Estuary may provide year-round rearing habitat.

Because steelhead use so much of the Russian River watershed, the proposed project has the opportunity to affect all lifestages and their habitat; however, the greatest effect would likely occur during juvenile rearing. Some of the most important project effects are related to summer rearing habitat in the Upper Russian River, Dry Creek, and the Estuary, which can be influenced by water management and by operations at the dams.

Channel maintenance activities in portions of the Central Sonoma Watershed Project and the Mark West Creek watershed have the potential to affect rearing, passage, and habitat conditions. However, many of the constructed flood control channels, particularly in the Rohnert Park-Cotati area, do not provide good rearing habitat for steelhead. The primary effect of channel maintenance in these areas, particularly in the Santa Rosa Creek

watershed and tributaries to Mark West Creek, would be on migration to steelhead habitat located upstream of the constructed channels. In those channel reaches that have the potential to support steelhead rearing (e.g. the nine channels identified in Section 5.4.2.2 that would be maintained with the original design maintenance scenario), channel maintenance activities may negatively affect steelhead habitat.

The integrated harvest program at DCFH and CVFF may have genetic and ecological effects on the naturally-spawning steelhead population. Implementation of a future integrated harvest program could potentially reduce some of these effects.

Localized effects may occur if individual adult or juvenile salmonids become entrained into the Riverfront Park lakes or Spring Lake (off Santa Rosa Creek) during high-flow events. Also, Mirabel/Wohler diversion facility operation and maintenance activities in the mainstem could affect salmonids, although improvements to the operations of these facilities should significantly reduce the risk of entrapment. Finally, localized habitat alterations in the mainstem could be affected by channel maintenance activities related to streambank erosion control activities.

Several project activities would benefit steelhead. For instance, the Flow Proposal would benefit summer rearing habitat in the Upper and Middle Russian River, as well as in the Estuary. Restoration actions in affected areas, including Dry Creek and tributaries in the Santa Rosa and Mark West creek watersheds, would have benefits for spawning and rearing habitat that could help to offset project effects from activities such as channel maintenance. Restoration actions in other tributaries, as well as watershed management activities, would likely contribute to the recovery of the species. Cumulatively, these proposals could provide an increase in steelhead production during the freshwater period.

6.2.1 Effects of the Proposed Project on Steelhead

In this section, project effects are integrated by life-history stage. Implementation of several project activities would likely either reduce negative effects relative to baseline conditions or provide potential benefit. Some ongoing activities, however, could still adversely affect steelhead and their habitat, particularly juvenile rearing and downstream migration.

6.2.1.1 Adult Upstream Migration

The proposed project should provide some benefit to steelhead during the upstream migration period. While there is the potential for some injury to individual fish and alteration of habitat, project activities would improve migration success for steelhead overall, relative to baseline conditions. Project activities that are expected to improve conditions for adult migration include the Flow Proposal (in Dry Creek), operations at Wohler and Mirabel infiltration ponds, habitat restoration programs, and maintenance practices in the flood control channels.

In the Russian River, implementation of the Flow Proposal would provide flows for upstream migration similar to the current D1610 management scenario. Daily flows for upstream migration in the mainstem are predicted to be suitable about 65 to 75 percent of

the time under current and buildout demand levels. Because upstream migration is generally cued by appropriate high flows, there are more than enough opportunities for steelhead to migrate upstream. The Flow Proposal also is expected to provide a high frequency of suitable flows for upstream migration in the upper portion of Dry Creek under *all* water supply conditions, which could enable more adult steelhead to reach suitable spawning areas in this region. Under the Flow Proposal, temperature would not be a problem for steelhead during the migration period. Thus the Flow Proposal should ensure good passage conditions throughout the Russian River.

Project changes to operations of the Wohler infiltration ponds, as well as fish rescues (primarily in the Mirabel ponds), would reduce the risk of entrapment for migrating steelhead. As described for coho salmon, there would be a small risk of entrapment at the Riverfront Park lakes (upstream of the Mirabel/Wohler area) and at Spring Lake (off of Santa Rosa Creek). However, because flooding of these reservoirs is infrequent, the overall risk to the population is low.

Habitat restoration projects in tributaries, including Dry Creek, would benefit fish passage. Instream structures in Dry Creek may slightly enhance passage to Dry Creek tributaries. Much attention has been given to restoration actions in Santa Rosa Creek in recent years. These projects improve habitat within the restored section in Santa Rosa Creek and provide enhanced passage opportunities to high-quality spawning and rearing habitat in upstream areas. This may help offset potential negative effects due to channel maintenance activities in constructed channels in this portion of the watershed.

The proposed project would reduce sediment and vegetation maintenance activities in constructed and natural flood control channels. Increases in riparian vegetation would improve conditions for fish passage through these channels by creating more habitat complexity and increasing the abundance of invertebrate prey. This would provide a greater opportunity for adult steelhead to reach upstream spawning and rearing habitat, especially in the Mark West Creek watershed.

Sediment maintenance activities in constructed flood control channels could pose a small risk to migration. While many flood control channels are of limited value for steelhead, good-quality habitat is located upstream of these channels in the Santa Rosa and Mark West Creek watersheds. The constructed flood control channels that are most likely to require substantial maintenance (including original design vegetation maintenance protocol) also provide passage to spawning and rearing habitat in Paulin, Piner, and Santa Rosa creeks. Channels that contain upstream rearing habitat only include Brush, Crane, Laguna de Santa Rosa, Rinconanda, and Todd creeks. In general, fish passage to these areas would continue to be affected by ongoing maintenance activities in the flood control channels; however, changes in maintenance practices would improve passage conditions relative to baseline.

6.2.1.2 Spawning and Egg Incubation

Flow conditions for spawning and incubation in the Russian River mainstem could pose a small risk to steelhead. Flows at this time of year are controlled primarily by natural

runoff and storm events rather than through water management. Therefore, it is expected that the Flow Proposal and D1610 would provide similar conditions for spawning and incubation. As a result of precipitation patterns in the Russian River, flows are generally too high for steelhead during this lifestage. Under *all* water supply conditions, good flows occur 15 to 25 percent of the time, with favorable flows occurring more frequently upstream, near Ukiah. The flow rates improve under *dry* water supply conditions, with good to optimal spawning and incubation flows occurring 25 to 40 percent of the time. Because flows are relatively high during spawning and remain high for most of the incubation period, redd scour could effect embryo survival success. Redd desiccation may also occur during the natural recession of flow, but is probably limited to small, localized areas.

In Dry Creek, the Flow Proposal provides slightly better overall conditions for spawning under *dry* water supply conditions, while D1610 is predicted to provide slightly better flows under *all* water supply conditions. Overall, flows in Dry Creek would be much more suitable for spawning and incubation compared to the Russian River mainstem. In general, the Flow Proposal would provide similar flows relative to baseline conditions, however, this effect is due to natural runoff patterns rather than project operations. During this portion of the year, the operation of Coyote Valley and Warm Springs dams has a very limited influence on flows.

Reductions in gravel-bar grading and vegetation maintenance activities related to streambank stabilization would be implemented to counter risks associated with high flows during the spawning and incubation period. This would help increase the amount of velocity refugia available to steelhead in the middle and upper mainstem, and should reduce the risk of redd scour while ensuring adequate delivery of DO to incubating embryos. The project would schedule stabilization activities later in the summer, after the incubation period is over. This practice should improve spawning and winter rearing conditions in the mainstem, which is important habitat for steelhead production. Rearing juveniles have higher growth rates in the mainstem relative to the tributaries, due to an increased abundance of invertebrates living in the Russian River (Chase et al. 2002). Since larger juveniles have higher ocean survival rates, they are more likely to contribute to future generations than steelhead reared in the tributaries.

Habitat restoration actions in Dry Creek, including instream and bank stabilization projects in tributaries, would also provide a benefit for steelhead spawning and incubation. These actions would improve habitat in Dry Creek and other tributaries by increasing the amount of pools and riffles within channels that would serve as prime spawning areas for steelhead.

6.2.1.3 Juvenile Rearing

As juveniles rear year round in freshwater streams, the amount of summer rearing habitat is an important limiting factor affecting the recovery of Russian River steelhead. The proposed project has the potential to substantially improve rearing habitat by improving summer rearing flows in the Upper Russian River and Dry Creek, implementing a low-

flow Estuary management program, and minimizing impacts to juveniles from construction and maintenance activities.

The Flow Proposal would result in improved summer rearing conditions on the upper mainstem Russian River, where some of the best rearing habitat occurs. Summer rearing flows under the Flow Proposal would provide lower water velocities in riffles and runs, especially between Ukiah and Cloverdale. Daily flows during June through October are predicted to provide good conditions for steelhead rearing 85 percent of the time under current and buildout demand levels. Under *dry* water supply conditions, the Flow Proposal and D1610 provide similar flows, yielding good rearing conditions over 90 percent of the time. The lower flows produced by the Flow Proposal under *all* water supply conditions would provide more suitable velocities for juvenile fish to hold in, while maintaining a steady supply of food and providing good juxtaposition of these velocities with cover elements within the river.

The benefits of the Flow Proposal would be more pronounced in Dry Creek. The Flow Proposal would result in reduced flows relative to D1610, thereby providing a substantial benefit to rearing steelhead during the summer months. Under *all* water supply conditions, daily flows would be good to optimal for rearing about 90 percent of the time compared to 34 to 55 percent of the time under current baseline management practices. Under *dry* water conditions, the Flow Proposal provides similar conditions for rearing, while flows under D1610 get worse. These improvements in rearing flows should help increase steelhead abundance throughout Dry Creek.

Implementation of the low-flow management of the Estuary would eliminate artificial breaching of the sandbar at the river mouth during the summer. This would benefit juvenile steelhead by improving water quality and temperature, assuring adequate water levels, increasing shoreline vegetation, and stabilizing the invertebrate food supply (Smith 1990). Overall, this would increase the amount of rearing habitat available to steelhead in the lower Russian River and would improve summer rearing conditions relative to the current D1610 management scenario. The proposed changes in gravel-bar grading and vegetation removal practices (conducted for streambank stabilization in the Russian River) have the potential to improve winter-rearing habitat relative to baseline conditions. In general, these activities would be scheduled to occur at one location at a time, to ensure that plenty of undisturbed rearing habitat remains available to support steelhead in the mainstem. While some local alterations to winter (and summer) habitat would occur during gravel-bar grading and vegetation removal, these alterations would not likely affect steelhead populations. Channel maintenance activities in constructed flood control channels that have the potential to support steelhead rearing, such as Santa Rosa Creek (see Section 5.4.2.2), may continue to negatively affect steelhead rearing habitat.

Proposed maintenance activities at Coyote Valley Dam would also likely improve rearing habitat for steelhead over baseline conditions. The potential to strand steelhead fry downstream of Coyote Valley Dam during maintenance would be reduced by decreasing ramping rates, providing 25-cfs bypass flows, and scheduling inspection and maintenance activities between July 15 and October 15. Because there is good summer rearing habitat

in the Upper Russian River, these measures could help increase juvenile abundance in the mainstem.

Project activities in the Mirabel and Wohler area of the Russian River may provide some benefit to juvenile steelhead; however, this benefit is likely to be small, as steelhead generally rear further upstream. Fish screens at the Mirabel and Wohler diversion facilities would reduce the risk for entrainment and impingement to a very low level. A reduction in the ramping rate of the inflatable dam at Mirabel would reduce the risk of stranding. Additionally, gravel-bar grading in the Wohler/Mirabel aquifer is expected to reduce the risk of entrapment to a low level.

Finally, the monitoring component of the project (e.g., SCWA monitoring study at the inflatable dam, population monitoring over multiple years in selected tributaries, and 2002 steelhead distribution study in the mainstem) would yield valuable data on the status of steelhead. These data are crucial for informed management decisions that support recovery efforts. Watershed management activities that lead to improved habitat conditions in the watershed (e.g., Fish Friendly Farming program, *Arundo* control efforts, and funding for KRIS database coordination) help support recovery efforts. Coordination with public and private entities, as well as the local community, helps to focus limited resources where they would do the most good. Although the effects of these actions are difficult to quantify, cumulatively they are likely to help sustain recovery efforts within the watershed.

6.2.1.4 Juvenile Downstream Migration

Project activities that affect passage conditions in the Russian River mainstem are most likely to affect downstream migration of juvenile steelhead. The greatest project benefits to steelhead migration are similar to those for coho salmon and are associated with changes in operations in the Mirabel and Wohler area. Project activities that are expected to improve conditions for downstream migration include the diversion structure and fish ladder at Mirabel, the notch in the inflatable dam, the regrading of the Wohler infiltration ponds, and upgrading the fish screens at the diversion intake structures (see Section 4.2). Some components of the proposed project in the Mirabel/Wohler region have the potential to directly affect migrating juveniles. For instance, when the infiltration ponds overtop, entrained smolts could become stressed and/or die, even with the proposed improvements and regrading activities. Inflation or deflation of the inflatable dam at Mirabel has the potential to strand juvenile fish; however, the proposed reduction in the ramping rate during the inflation process would substantially reduce this risk. Finally, there is the potential for smolts to become entrained in Spring Lake or Riverfront Park lakes during high-flow events. However, given the low probability of such an event occurring, the risk to young steelhead is relatively low.

Juvenile steelhead must pass through the Estuary in order to reach the sea. Since most smolts migrate during the early part of the year, when the Estuary is still open to the ocean, potential effects on outmigration would likely be minimal. Negative effects could occur during *critically dry* years when low flows may result in spring sandbar closures.

However, if habitat conditions in the lagoon are good, juvenile fish may benefit from additional rearing time in a food-rich environment that may develop in the lagoon.

6.2.1.5 Fish Production Programs

The project will continue to operate a hatchery program to stock the Russian River with steelhead for recreational fishing. Because of the uncertainty in the level of genetic divergence between the natural and hatchery-reared steelhead within the basin, the fishery will be operated as an isolated harvest program. The program will collect returning hatchery-reared steelhead and use them as broodstock to produce juveniles. This will help minimize ecological interactions with wild Russian River steelhead populations, while mitigating for the loss of steelhead habitat due to the construction of the Warm Springs and Coyote Valley Dams.

The proposed operation of the DCFH and CVFF hatcheries could pose a small genetic and/or ecological risk to the naturally-spawning populations. Angling for hatchery-produced fish could also result in incidental harm or mortality of naturally-spawned steelhead. To reduce the effects of the hatcheries on wild steelhead, USACE would evaluate the effectiveness of an integrated harvest program, which would incorporate naturally-spawned steelhead into hatchery broodstock, on maintaining genetic diversity. By combining hatchery and naturally-spawning populations, managers may be able to increase genetic diversity in hatchery-raised fish, so that they are more adapted to local physical conditions. If successful, this program could be used to supplement Russian River steelhead, should natural populations begin to decline. Implementation of a future integrated recovery/harvest program at the DCFH and CVFF could help recovery efforts for the naturally-spawning population if data indicate it is warranted. Overall, implementation of the integrated hatchery program should reduce genetic and ecological risks to wild and hatchery steelhead.

6.2.2 Integration of Effects

Of the three listed salmonid species in the Russian River system, steelhead are the most widespread and possibly abundant. As a result, steelhead may be influenced by the full range of environmental effects produced through project activities associated with channel maintenance and water management operations in the watershed. Steelhead also have a protracted freshwater rearing phase lasting up to two years or more and, unlike coho salmon and Chinook salmon, do not have a relatively fixed three-year lifecycle. This means that juveniles will be influenced by activities in the river and the watershed for much longer; hence, project activities can affect all lifestages and the habitats associated with them.

Overall, under the proposed project, the environmental conditions in the Russian River system would likely be beneficial to the continued survival of steelhead in the river system, and stocks would likely improve compared to baseline conditions (Table 6-3). There would be relatively few direct effects on steelhead mortality associated with the proposed project, and the few effects that could occur would likely be small and

localized. Most of the effects on steelhead would arise as a result of project activities on habitat conditions, which in turn could influence the various lifestages (Table 6-4).

One potential difficulty when evaluating the possible effects of any human activities on the various lifestages of salmonids in river systems is in identifying possible "bottlenecks" that may limit salmonid production in freshwater (Reeves et al. 1991). The importance of biological monitoring and research programs in this process should not be underestimated (Karr and Chu 1998). In this regard, the SCWA monitoring studies at

Table 6-3 Potential Project Benefits to Steelhead

Life-History Stage	Project Benefits
Adult upstream migration	Fish passage projects would improve access to upstream habitat.
Spawning and incubation	Instream habitat structures in Dry Creek would help maintain spawning gravels.
Juvenile rearing	The Flow Proposal would improve flows for summer rearing in Dry Creek and the Upper and Middle Russian River.
	Elimination of summertime artificial breaching of the sandbar would improve summer rearing in the lagoon.
	Recycled-water projects would improve conditions in selected tributaries.
	Watershed management activities and data collected in studies and monitoring programs would support management decisions.
	Instream habitat structures in Dry Creek would help maintain spawning gravels.
Juvenile downstream migration	Improved fish screens, modifications at fish ladder, and notch in inflatable dam would improve passage.
	Exit channel at Wohler infiltration pond, regrading of ponds at Wohler and Mirabel diversions reduce risk of entrapment.

Table 6-4 Potential Project Effects on Steelhead

Life-History Stage	Low Continued Risks
Juvenile downstream migration	Stranding during inflation of Mirabel inflatable dam.
	Entrapment in Mirabel or Wohler infiltration ponds. Risk reduced to very low level.
	Entrapment in Riverfront Park lakes and Spring Lake.
Juvenile rearing	Gravel-bar grading and vegetation maintenance in the mainstem would affect habitat. Protocols would be implemented to reduce effects from baseline.
	Channel maintenance in several constructed flood control channels that have the potential to support juvenile rearing may reduce habitat value.
Adult migration	Sediment and vegetation maintenance in constructed flood control channels may reduce upstream and downstream passage to and from good quality habitat upstream.

Mirabel, population monitoring over many years in selected tributaries, as well as the mainstem snorkel survey carried out in fall 2002, have yielded important information about the status of steelhead in the watershed, which is needed to make effective management decisions.

The primary effect of the Flow Proposal in the Russian River would be to improve steelhead summer rearing habitat by reducing summer flows relative to D1610. This is especially true in the area between Cloverdale and the Forks, which provides the best steelhead rearing habitat in the mainstem. Reduced flows in Dry Creek would provide a substantial benefit to rearing steelhead during the summer months relative to current management under D1610. In general, the improved rearing flows throughout the Russian River basin could result in a marked increase in juvenile survival. This increase in survival should translate into future increases in adult abundance and a reduced risk of population extinction.

There is the potential for considerable positive effects on steelhead spawning and rearing from the habitat restoration projects currently being carried out throughout the watershed, and which will continue as part of the proposed project. Stream habitat improvement is now an established and proven discipline in river management programs, and has been shown to alleviate, restore, and mitigate the adverse changes produced through land and water resource development projects (Reeves et al. 1991; Wissmar and Bisson 2003). Habitat improvement programs can both revitalize natural river features, such as the pool-riffle pattern, and lead to an overall increase in habitat diversity, which is an essential habitat requirement in the population ecology of listed salmonids. The clear and direct correlation between the level of instream habitat diversity and levels of stream fish abundance are well documented in the scientific literature (Hicks et al. 1991). The widespread habitat restoration programs being undertaken in the Russian River watershed would continue to improve habitat, and help counteract any possible detrimental effects of other operations and maintenance activities.

The implementation of a future integrated recovery/harvest program at the DCFH and CVFF may also help recovery efforts of naturally-spawning population if data indicate it is warranted. Genetic and ecological risks from an isolated harvest program may be reduced with the implementation of an integrated hatchery program.

In addition to suitable spawning, incubation, and rearing habitat, steelhead populations also require unrestricted migratory corridors for both adults and juveniles (Bjornn and Reiser 1991). Project activities associated with the improvements of fish screens at Mirabel, the grading of the Wohler infiltration ponds, and modifications to maintenance activities in the flood control channels should allow improved passage relative to baseline for both juvenile and adult steelhead. This could help increase the number of adults that spawn in upstream channels and improve the survival rate of juveniles as they migrate to the sea.

Other project activities that would benefit steelhead include the changes to the ramping rates at Coyote Valley and Warm Springs dams, elimination of summertime artificial breaching of the sandbar, and recycled water projects. These activities would reduce the

chance of take due to stranding of juveniles and help improve water quality in rearing habitat.

There are still some ongoing risks to steelhead in the Russian River. These risks are primarily associated with migration. The biggest risk to migrating juveniles would be entrapment in Riverfront Park and Spring Lake reservoirs during flood events. Entrapment in Mirabel or Wohler infiltration ponds would also be possible and could lead to migration delays and an increased chance of predation. There would also be the possibility that juveniles could become stranded during inflation of the Mirabel Dam. For migrating adults, sediment and vegetation maintenance in constructed flood control channels could reduce passage to good-quality habitat upstream. In reaches of constructed flood control channels with the potential to support rearing salmonids (such as Santa Rosa Creek), channel maintenance activities may reduce the habitat value for rearing salmonids. In general, the risks to steelhead from these project activities would be small and would not change from baseline conditions. Given the overall benefits of the project for steelhead, any loss of individuals due to these activities should be more than made up for by the beneficial effects associated with the project.

6.3 CHINOOK SALMON

Early adult Chinook salmon have returned to the Russian River as early as mid-August. The peak run generally begins in October or November, and upstream migration continues into mid-January. Spawning takes place from November through January. Eggs incubate for a longer period than for coho salmon and steelhead, and the incubation period occurs from November through March. After emerging from the gravel, juvenile Chinook salmon rear in fresh water for only two to four months (February through May) before migrating downstream (February through June), compared to the more protracted freshwater rearing (1 to 2 years) of coho salmon and steelhead. Therefore, there is a relatively short time-period (November through June) during which fry and juveniles are susceptible to the negative and positive effects of the proposed project.

Adult Chinook salmon spawning habitat is located primarily in the Upper and Middle Russian River mainstem and in selected tributaries such as Dry Creek. A redd survey conducted in the mainstem in 2002 documented spawning as far downstream as Healdsburg (Cook 2003b). Chinook salmon rearing occurs in the Russian River mainstem, selected tributaries such as Dry Creek, and the Estuary.

One of the most beneficial components of the proposed project is SCWA's data collection effort. Monitoring studies and genetic studies are producing data that are crucial to informed management decisions for Chinook salmon recovery. Benefits would also be realized for spawning Chinook salmon by eliminating summertime artificial breaching of the sandbar, which would prevent early migrants from entering the river prematurely. Elimination of the Chinook salmon production program at DCFH would eliminate risks associated with hatchery production, although an integrated recovery program at the hatchery could be readily implemented in the future, if needed. Finally, habitat restoration actions in Dry Creek or other tributaries would benefit Chinook salmon.

The proposed project would have some limited opportunity to negatively affect salmon except in small, localized areas. Specific localized risks include entrainment at the Mirabel infiltration pond and the Riverfront Parks property, and sedimentation and injury to individuals from bank stabilization activities in the mainstem Russian River. The project would not likely affect spawning and egg incubation.

The most substantial effects, negative and beneficial, would likely occur for juvenile rearing in the mainstem and in Dry Creek from water management operations at the dams and channel maintenance activities in the mainstem. Important project effects would also be related to interactions between downstream migrants and the diversion facilities and infiltration ponds, many of which would be improved over baseline conditions.

6.3.1 Effects of the Proposed Project on Chinook Salmon

6.3.1.1 Fish Production Facilities and Other Restoration Actions that Affect all Life-History Stages

One of the most important components of the proposed project is SCWA's data collection effort. Monitoring conducted to assess project effects and studies conducted as part of restoration actions are producing data that will lead to informed, effective management decisions for Chinook salmon recovery.

SCWA monitoring data at the Mirabel inflatable dam indicate there is a relatively strong spawning run in the Russian River. In the year 2000, SCWA monitored the entire Chinook salmon run for the first time, and estimated a run of approximately 1,500 fish. A partial run count of 1,299 adult salmon through November 13, 2001 suggests the 2001 run was substantially larger than the previous year. A total of 5,466 adult Chinook salmon were observed in 2002, and 6,083 adults were observed in 2003. Data collected during a 2002 redd count and during smolt trapping studies at Mirabel indicate juvenile Chinook salmon production has increased in recent years.

Although long-term data are needed to accurately document population trends, recently collected data are providing information for management decisions, such as halting Chinook salmon hatchery production at this time. SCWA-funded genetic studies conducted at the Bodega Marine Laboratory determined that the naturally-spawning population is not immediately at risk of inbreeding, and that genetically, the existing population may represent a component of a diverse set of local populations.

Since hatchery production of Chinook salmon would not occur under the proposed project, potential genetic and ecological risks associated with baseline hatchery production would be eliminated. If new information indicates that populations were declining, an integrated recovery (supplementation) program would be implemented for Chinook salmon. Protocols would be implemented to minimize risks of hatchery production to the fullest extent possible. The benefits to recovery of the species would likely outweigh potential risks of genetic and ecological effects of hatchery production.

6.3.1.2 Adult Upstream Migration

The proposed project would likely have only small, localized effects on Chinook salmon upstream migration. The most important direct effects are associated with management of the Estuary as a closed system, the entrainment of adults into the Mirabel infiltration ponds or Riverfront Park lakes, and any incidental take due to fishing. Alterations to habitat under the Flow Proposal could also affect migration. Another proposed action that could benefit Chinook salmon upstream migration is the flood control flow management at Lake Mendocino. Water releases from Coyote Valley Dam would occur from mid to late October, and would augment flows in the Russian River. These flows may open the mouth of the River. Channel maintenance activities in the mainstem may also alter habitat somewhat, but are not expected to impede migration of spawners.

Direct effects to Chinook adults may include a risk of entrainment into the Mirabel and Wohler infiltration ponds. However, the risk of injury or mortality is low. The risk is slightly higher for the Riverfront Parks lakes, but even in these regions, the frequency of flood flows sufficient to entrain salmon is low. Chinook salmon may also be affected by incidental harvest bycatch and hooking mortality as a result of the proposed steelhead fish production program at DCFH and CVFF. Cumulatively, the risk to the population from these direct effects is likely to be low.

The Flow Proposal is designed to protect juvenile steelhead rearing habitat, and to allow the Estuary to be managed as a closed system. When the Estuary is managed in this fashion, Chinook salmon would be unable to enter the river until the onset of the rainy season, or until the USACE begins releasing additional water from the reservoirs to bring them down to flood control stage for the winter (generally in mid-October). This would benefit Chinook salmon by preventing them from entering the river during August and September, when flows are low and temperatures are warm.

Flow conditions in November through January for migrating adults would be generally similar between D1610 and the Flow Proposal under *all* water supply conditions, with daily flows suitable for passage about 77 percent of the time near Healdsburg, and 87 percent of the time in the Upper Russian River (Ukiah). In *dry* water supply conditions, the Flow Proposal provides better upstream migration conditions downstream of Cloverdale, with suitable flows predicted to occur about 60 percent of the time compared to 40 percent of the time for D1610. Since stressful water temperatures can occur in the mainstem in August and September, the Flow Proposal would provide better overall conditions for upstream migration relative to baseline conditions.

Both water management scenarios provide similar conditions for upstream migration under all water supply conditions, however, under *dry* water supply conditions, D1610 provides slightly better upstream migration conditions than the Flow Proposal for current and buildout demand levels. This decrease in flow in *dry* water years is the result of lower flows during October, which are designed to improve juvenile rearing habitat for coho salmon and steelhead in Dry Creek. However, upstream migration opportunities (78 percent of the time) would be plentiful under the Flow Proposal, particularly during the

peak spawning migration period. Excellent temperature and DO conditions for all lifestages of Chinook salmon would occur under D1610 and the Flow Proposal.

Channel maintenance, particularly gravel-bar grading and vegetation removal for streambank stabilization, would result in habitat alterations. Under the proposed project, the level of work would be reduced and protocols to reduce the effects to salmonid habitat would be implemented. This would reduce the overall effect to Chinook salmon over baseline conditions. Conditions have been, and would likely continue to be, suitable for upstream migration in the mainstem.

Habitat restoration actions would have some limited benefits to upstream migration, particularly fish passage projects that may improve access to upstream spawning and rearing habitat. Primary spawning habitat is likely to be found in the mainstem, Dry Creek, and the lower reaches of tributaries, so the benefit to Chinook salmon upstream migration may not be substantial. However, restoration actions that improve the interconnectivity of habitat and that restore upstream habitat are likely to result in benefits to Chinook habitat.

In summary, the proposed project would likely have only small, localized effects on Chinook salmon upstream migration. The proposed Estuary management portion of the Flow Proposal would benefit Chinook salmon by keeping them from entering the river in August and September, when flows and temperatures are unsuitable. Direct effects to individual adult fish could occur in that fish could occasionally be entrained in the Riverfront Park lakes or be subject to incidental fishing pressure related to the proposed steelhead production program. However, the risk to the population is likely to be low. The proposed project would reduce the risk of entrainment at the Mirabel and Wohler diversions. Suitable habitat conditions would be available for upstream passage during the peak migration period through the Estuary, in the mainstem, and in Dry Creek. Flows under the Flow Proposal would be similar to baseline conditions from November through January and would not substantially affect adult Chinook migration habitat, in itself. Instream restoration actions could also have some small benefits for upstream migration.

6.3.1.3 Spawning and Egg Incubation

Spawning and egg incubation occur in the upper and middle sections of the Russian River, as well as in Dry Creek. The Flow Proposal would not change flow-related habitat or water temperature conditions during these periods in the Russian River mainstem or in Dry Creek. The proposed project would not likely have direct effects on Chinook salmon spawning or incubation. Habitat in the mainstem may potentially be affected by channel maintenance (gravel-bar grading and vegetation maintenance) related to streambank erosion control. Some benefits may be realized by restoration actions.

Gravel-bar grading and creation of overflow channels would affect the geomorphology of the channel by decreasing sinuosity and reducing hydraulic diversity and associated aquatic habitat diversity. Gravel-bar grading is closely interrelated with removal of vegetation on bars, which may reduce the extent of cover and lead to increased water temperatures, which may also affect the survival of incubating eggs. However, the

proposed project would reduce effects to Chinook salmon habitat over baseline conditions.

Habitat restoration actions that reduce streambank erosion and sediment runoff would reduce sedimentation of downstream spawning and incubation habitat. Restoration actions in Dry Creek would also improve spawning and incubation habitat.

In summary, the proposed project is not likely to degrade conditions for spawning and egg incubation in the Upper Russian River or in Dry Creek over baseline conditions, and in some cases, it would improve them. Data from SCWA monitoring at the Mirabel inflatable dam and a redd survey conducted in the fall of 2002 indicate that under baseline conditions, successful spawning and incubation occurs upstream. Because negative effects would be reduced from baseline conditions, there would likely be a small net benefit in the quality of Chinook salmon spawning and incubation habitat over baseline conditions.

6.3.1.4 Fry and Juvenile Rearing

Of all the lifestages, the project is most likely to affect fry and juvenile rearing and downstream migration. Implementation of the Flow Proposal would improve rearing habitat in Dry Creek, particularly during drought years.

One of the most substantial benefits to fry and juvenile rearing would occur from proposed modifications at Coyote Valley Dam. Under baseline conditions, there is a potential for stranding juvenile salmonids when releases from the dam are ramped down for inspection and maintenance activities. Under the proposed project, inspection and maintenance activities would be timed to occur when Chinook salmon fry are not present in the river. Two pumps would be installed to provide a 25-cfs bypass flow when releases from the dam are shut down, and ramping rates would be reduced.

The most substantial negative effect to Chinook salmon is likely to occur from indirect habitat alterations resulting from bank stabilization (gravel-bar grading and vegetation maintenance) in the Upper Russian River mainstem. As primary spawning and rearing habitat occurs in the Upper Russian River, these activities could potentially affect all life-history stages of Chinook salmon, but the effects would be greatest for Chinook salmon rearing. Under the proposed project, protocols would be implemented to reduce the effect on rearing habitat. Under baseline conditions, extensive reaches in the river could potentially be affected by gravel-bar grading and vegetation maintenance. As discussed in previous sections, the extent of the work would be limited under the proposed project, and protocols would be implemented to protect salmonid habitat. Although habitat would be altered at sites worked on, the limitations under the proposed project are designed to ensure that sufficient, good-quality habitat remains in the mainstem to support the Chinook salmon population.

Instream habitat improvements planned in Dry Creek would improve conditions for fry and juvenile rearing by providing additional high-flow refuge areas and cover for rearing.

Chinook salmon also benefit from the fish passage project constructed at Mumford Dam, which now provides access to high-quality spawning and rearing habitat.

In summary, the most substantial negative project effects would occur from channel maintenance activities conducted in the Upper Russian River. However, these effects would be reduced over baseline conditions and protocols would be implemented to provide sufficient habitat for Chinook salmon rearing. These effects are offset slightly by beneficial effects that would occur from changes in the operation at Coyote Valley Dam (during annual inspections and maintenance), as well as habitat improvements in Dry Creek and other tributaries. Recent data from SCWA studies indicate that successful reproduction and rearing occur in the Russian River mainstem under baseline conditions, and reductions in negative effects under the proposed project would likely improve rearing-habitat conditions.

6.3.1.5 Downstream Migration

Although there would likely be direct effects to individual migrating juvenile fish, particularly in the Lower Russian River, implementation of the proposed project would reduce the risk from baseline conditions to a low level. There would not likely be substantial effects to habitat.

Among the most important components of the proposed project for Chinook salmon downstream migration are the improvements proposed at the Mirabel and Wohler diversion facilities. Under baseline conditions, there was a potential to entrain juvenile Chinook salmon in the infiltration ponds, both during the low-flow diversion season and during high-flow events that overtop the levees next to the ponds.

Fish screens at the Mirabel and Wohler diversion facilities would be upgraded to meet NOAA Fisheries criteria for fry and juveniles. Data from SCWA's Mirabel study indicate Chinook salmon in the Russian River emigrate through the Wohler Pool at about 90 mm FL (range 54-140 mm). NOAA Fisheries defines fry as less than 60 mm FL (NMFS 1996c). Therefore, juvenile-size fish are most likely to benefit.

The diversion structure and fish ladder on the west side of the inflatable dam would be integrated, and the fish screens would be upgraded to improve downstream fish passage. Implementation of a notched configuration in the inflatable dam during downstream migration periods would also facilitate downstream fish passage, although data from the monitoring program suggest Chinook downstream migration does not appear to be delayed in Wohler Pool or at the inflatable dam under baseline operations. Implementation of these measures would result in good fish passage conditions, with minimal to no delays, for Chinook salmon juveniles.

As discussed in the previous section, gravel-bar grading and vegetation removal activities carried out for streambank stabilization in the mainstem Russian River have the potential to affect juvenile Chinook salmon habitat. Under the proposed project, these activities would be much more limited, and protocols would be implemented to reduce effects to

salmonid habitat. Furthermore, the effects to migration would be expected to be far less than for rearing.

In the Wohler/Mirabel area, direct effects to some individual fish may occur from gravel-bar grading that is done to increase infiltration rates. Implementation of protocols verified during the monitoring study at Mirabel is likely to reduce the risk to a low level. Inflation or deflation of the inflatable dam could potentially result in stranding of migrating fish. Juvenile fish could be entrained into the Mirabel or Wohler infiltration ponds for short periods of time during high-flow events or during the spring portion of the diversion season, but modifications to the fish screens and grading of the ponds would reduce the risk to a very low level. The risk to juvenile Chinook salmon is higher if they are entrained in the Riverfront Park during high-flow events, because they would be lost to the anadromous population. However, this would not happen frequently, so the risk to the population is low.

Juvenile Chinook salmon pass through the Estuary during outmigration from the Russian River. Since peak outmigration occurs during the early part of the year when the Estuary is still open to the ocean, effects on juvenile outmigration would generally not be expected. However, during *critically dry* years, low flows may result in spring sandbar closures. By eliminating artificial breaching, passage to the ocean may not be available as often as it may have been with artificial breaching conducted under baseline conditions. However, if habitat conditions in the lagoon are good, juvenile fish may benefit from additional rearing time in a food-rich environment that is likely to develop in the lagoon.

In summary, implementation of the proposed project would likely result in a net benefit to juvenile Chinook salmon migration due to improvements that would be made at Coyote Valley Dam and the Mirabel/Wohler diversion facilities. Structural and operational changes at Coyote Valley Dam (bypass flows and changes in ramping and scheduling of activities) would reduce or eliminate risks to rearing juvenile Chinook salmon in the Upper Russian River. Downstream passage of juvenile Chinook salmon would improve due to structural and operational changes of the Mirabel/Wohler diversion facilities, particularly from upgrades to the fish screens and grading of the infiltration ponds, and from a reduction in the rate of inflation of the inflatable dam. Implementation of protocols that limit effects of gravel-bar grading in the Mirabel and Wohler area would reduce direct effects to migrating Chinook salmon juveniles to a low level and improve conditions over baseline operations. Some minor benefits may occur from changes in the operation of the fish ladder and notching of the dam to facilitate downstream passage of smolts. Direct effects to some individual fish may occur during operation and maintenance activities, but cumulatively, the risk is likely to be low. Habitat alterations may occur from channel maintenance activities in the Upper Russian River, but they are not expected to have substantially negatively effects on migrating fish.

6.3.2 CHINOOK SALMON RESPONSE TO THE PROPOSED PROJECT

The overall effects of the proposed project are summarized in Tables 6-5 and 6-6. In general, the proposed project would result in net benefits to Chinook salmon and their habitat. Some potential direct effects could result in injury or mortality of some

individuals, particularly migrating adults and juveniles. Some of the channel maintenance actions also would negatively affect habitat, particularly in the Upper Russian River. Overall, under the proposed project, the conditions in the Russian River system would likely be beneficial to the continued survival of Chinook salmon in the river system, and would likely be improved over baseline conditions.

Among the most important benefits of the proposed project for Chinook salmon is eliminating the artificial breaching of the sandbar at the mouth of the Estuary during the summertime. By managing the Estuary as a closed system, upstream migration of Chinook salmon would often not begin until November, when the sandbar at the mouth of the Estuary is breached (either artificially or by rainfall). This would help ensure that returning spawners enter the Russian River when flows are more suitable for upstream migration, and should lead to an increase in the number of adults reaching spawning grounds throughout the mainstem and Dry Creek.

Table 6-5 Potential Project Benefits to Chinook Salmon

Life-History Stage	Project Benefits
All lifestages	Data from studies and monitoring are crucial to informed management decisions.
	Ecological and genetic risks to Chinook salmon would be eliminated with elimination of hatchery production. An integrated recovery program could be rapidly implemented if needed.
Adult migration	Elimination of summertime artificial sandbar breaching would help prevent premature entry of early spawners.
	Fish passage improvement projects would make tributary habitat available.
	Exit channel at Wohler infiltration ponds during high-flow season reduces risk of entrainment to very low level.
Juvenile rearing	Schedule dam inspection and maintenance activities when fry are not present. Reduce ramping rates at low flows and install pumps at Coyote Valley Dam to provide bypass flows.
	Instream habitat improvements in Dry Creek.
	With implementation of the Flow Proposal, rearing habitat in Dry Creek would be much better in dry years.
Juvenile migration	Improved fish screens at Mirabel and Wohler diversions.
	Exit channel at Wohler infiltration ponds during high-flow season reduces risk of entrainment to a very low level.
	Structural and operational improvements at Mirabel inflatable dam would improve fish passage.

Table 6-6 Potential Project Effects on Chinook Salmon

Life-History Stage	Low Continued Risks
Adult migration	Entrainment in Mirabel infiltration ponds.
	Entrainment in Riverfront Park lakes.
	Incidental harvest bycatch and hooking mortality from steelhead integrated harvest program.
Adult and juvenile migration, spawning and egg incubation	Localized habitat alterations from gravel-bar grading and vegetation removal in mainstem. (Proposed project would improve conditions over baseline.)
Juvenile rearing	Localized habitat alterations from gravel-bar grading and vegetation removal in Upper Russian River mainstem. Conditions would improve over baseline.
Juvenile migration	Gravel-bar grading in Mirabel and Wohler area.
	Inflation of the Mirabel inflatable dam may strand young fish.
	Entrainment and fish rescues in Mirabel and Wohler infiltration ponds.
	Entrainment in Riverfront Park lakes.

Other project activities that would improve upstream and downstream passage include improved fish screens at Mirabel and Wohler diversions, the exit channel at Wohler infiltration ponds, operational improvements at Mirabel inflatable dam, and instream restoration projects. These activities would have the same effect as reducing habitat fragmentation by making it easier for fish to access more of the Russian River watershed.

Data collected from ongoing field studies and monitoring activities also would benefit Chinook salmon. These studies would provide valuable information to support informed management decisions in recovery planning.

Cessation of hatchery production would help eliminate genetic and ecological risks associated with hatchery production. A proposed Chinook salmon supplementation recovery program could be rapidly implemented if future monitoring efforts indicate it is warranted. This program would collect wild returning adult Chinook salmon and use them as broodstock to build a naturally sustaining Chinook salmon population.

Finally, implementation of the Flow Proposal would improve rearing habitat in Dry Creek, particularly in *dry* years. In general the Flow Proposal is predicted to provide good to optimal flow conditions for rearing about 85 percent of the time in upper Dry Creek, which is almost twice as high as the current D1610 management scenario. Thus, rearing habitat for juvenile Chinook salmon in drought years should improve greatly compared to the baseline conditions.

Project operations that negatively affect primary rearing and migration habitat in the mainstem of the Russian River and Dry Creek are most likely to affect the Chinook

salmon population. Habitat alterations could occur from channel maintenance activities in the mainstem of the Russian River, and this may affect habitat for juvenile fish in the Upper Russian River. However, protocols would be implemented to reduce effects over baseline conditions and would likely preserve sufficient rearing habitat. Direct effects to fish could also occur at the Mirabel and Wohler diversion facilities and at the Riverfront Park.

The proposed project would reduce a number of effects under baseline conditions to a low or negligible level, and would likely result in a net benefit to Chinook salmon. Beneficial effects are likely to accrue to juvenile rearing and downstream migration through structural and operational modifications at Coyote Valley Dam and at the Mirabel and Wohler diversion facilities. Furthermore, implementation of the Flow Proposal would enable implementation of the Estuary management proposal, which could help protect early Chinook spawners. Revised protocols for channel maintenance in the Upper Russian River would reduce effects to habitat relative to baseline conditions.

Although effects to individual fish and Chinook habitat would likely occur, there would likely be a net benefit to the Chinook salmon population with implementation of the proposed project.

THIS PAGE INTENTIONALLY LEFT BLANK.